PATENT SPECIFICATION

903,287

DRAWINGS ATTACHED.

Date of Application and filing Complete Specification :
Oct. 14, 1959. *No. 34848/59.*

Application made in United States of America (No. 775,834) on Nov. 24, 1958.

(Patent of Addition to No. 859,862, dated Feb. 19, 1959).

Complete Specification Published : Aug. 15, 1962.

Index at Acceptance :— [illegible]

ERRATA

SPECIFICATION NO. 903,287

Page 1, line 67, *for* "fasoin" *read* "fashion"

Page 2, line 89, *after* "opening" *insert* "when"

Page 3, line 57, *for* "235" *read* "325"

Page 4, line 17, under "Parts by weight" *for* "1563.47" *read* "1563.74"

Page 4, line 87, *for* "wtih" *read* "with"

Page 6, line 70, *for* "Figure 4" *read* "Figure 2"

THE PATENT OFFICE,
8th November, 1962

DS 67854/1(5)/R.109 200 10/62 PL

The invention constitutes an improvement on that disclosed in our Application No. 5782/59, (Serial No. 859,862).

As mentioned in that Application, refrigerators, especially those of the type used in the home, employ a gasket or sealing means between the door and the body of the cabinet to cushion the door in closing, to prevent the passage of air when the door is closed and provide a heat-insulating barrier in this region. These gaskets are generally formed of rubber, synthetic plastic or other elastomeric material which have rubber-like properties so they can deform under pressure and thereby provide a seal between the cabinet and the door even though there be irregularities in the surfaces of these members. Heretofore, it has been customary to form the gasket of a material and in a configuration such that considerable pressure is required to deform the gasket sufficiently to provide effective sealing action around the entire door opening. This has made it necessary to utilize door latches which produce a srong clamping

The success of a gasket in providing effective sealing action for refrigerators or similar cabinets depends in a large measure upon its ability to deform sufficiently to accommodate the unavoidable irregularities in the adjacent surfaces of the cabinet and door between which the gasket is placed. In order to permit such accommodation, the magnet disclosed in our above mentioned Application was formed as a series of short magnetised blocks which are held together in a flexible fashoin by adhering them in face-to-face contact to an elongated flexible strip. Such a magnet system tends to be more expensive than is desirable.

The present invention is concerned with improving or modifying this magnet by deriving its flexibility not from the splitting up of the magnetic material into blocks but instead from the inherent characteristics of the material employed, so that both the formation of blocks and the need to employ a supporting flexible strip are avoided, and according to this invention, a flexible magnet is provided comprising finely di-

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Index at Acceptance :—**Classes 38(2)**, D(2 : 3A : 4 : 6A : 6B : 8B : 8D); **29**, H5; **35**, P5; **44**, BE19; and **122(3)**, N1(B : G).

International Classification:—H01d. E05c. F06j. F25d. H01d.

COMPLETE SPECIFICATION.

Flexible Magnet.

We, THE B.F. GOODRICH COMPANY, a corporation organised under the laws of the State of New York, United State of America, of 230 Park Avenue, New York, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a flexible magnet which is able to hold itself against a magnetically permeable article and relates also to a gasket containing such a magnet for use in refrigerators and similar cabinets. The invention constitutes an improvement on that disclosed in our Application No. 5782/59, (Serial No. 859,862).

As mentioned in that Application, refrigerators, especially those of the type used in the home, employ a gasket or sealing means between the door and the body of the cabinet to cushion the door in closing, to prevent the passage of air when the door is closed and provide a heat-insulating barrier in this region. These gaskets are generally formed of rubber, synthetic plastic or other elastomeric material which have rubber-like properties so they can deform under pressure and thereby provide a seal between the cabinet and the door even though there be irregularities in the surfaces of these members. Heretofore, it has been customary to form the gasket of a material and in a configuration such that considerable pressure is required to deform the gasket sufficiently to provide effective sealing action around the entire door opening. This has made it necessary to utilize door latches which produce a srong clamping force. In an effort to avoid the need for such latches, attempts have been made to employ door gaskets requiring only a light compressive force to effect conformation to the surfaces engaged, this force being supplied by magnetic means. Although such magnetic door gaskets have many advantages over the conventional combination of latch and stiff gasket, nevertheless, they have not heretofore received wide acceptance. This is partly because the gaskets in some cases have not provided the necessary sealing action but more importantly because the cost of manufacture has been excessive.

The success of a gasket in providing effective sealing action for refrigerators or similar cabinets depends in a large measure upon its ability to deform sufficiently to accommodate the unavoidable irregularities in the adjacent surfaces of the cabinet and door between which the gasket is placed. In order to permit such accommodation, the magnet disclosed in our above mentioned Application was formed as a series of short magnetised blocks which are held together in a flexible fashoin by adhering them in face-to-face contact to an elongated flexible strip. Such a magnet system tends to be more expensive than is desirable.

The present invention is concerned with improving or modifying this magnet by deriving its flexibility not from the splitting up of the magnetic material into blocks but instead from the inherent characteristics of the material employed, so that both the formation of blocks and the need to employ a supporting flexible strip are avoided, and according to this invention, a flexible magnet is provided comprising finely di-

vided particles of baruim ferrite or a ferrite of equivalent magnetic retentive properties, the ferrite being bonded together by a thermoplastic resin containing a plasticiser so as to make up a self-supporting body of minimum dimension greater than the thicknes of a magnetic recording tape, the body being magnetised in such a manner and to such a degree as to constitute a permanent magnet able to hold itself against a magnetically permeable article, the particles being present in the body in the range of 30% to 93% of the total weight of the magnet and the size of the particles being such that they will all pass through a screen the openings of which have a transverse dimension of the order of 0.0017 inches. Such a magnet is readily and cheaply made and does not depend for its flexibility upon a separate flexible supporting strip. In addition, the magnet may be provided with any desired arrangement of magnetised poles. This permits many uses for the magnet in addition to incorporation in gaskets for refrigerators or similar cabinets.

When incorporated in a gasket for a refrigerator, the gasket preferably comprises an elongated flexible body having a longitudinally extending portion for attaching to the door of the cabinet, a portion carrying the flexible magnet, whose function is to attract the cabinet body, and an intermediate portion which is integral with the other portions and which permits of a relative movement between them to allow the magnet to take up different longitudinal configurations with respect to the attaching portion. The magnet is arranged to extend along the flexible body of the gasket and is able to take up its different longitudinal configurations to accommodate irregularities in the cooperating surfaces of the door and the cabinet body.

When employed on a cabinet, such a gasket is made as an endless gasket to serve as a seal between the door and the periphery of the cabinet body around its opening, and the gasket serves to hold the door, when closed, against the cabinet body.

An example of a magnet according to the invention, and also examples of a gasket and a refrigerator incorporating such a magnet, will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a front elevational view of a refrigerator with the door in open position and showing a gasket provided with permanent magnets in accordance with this invention;

Fig. 2 is a cross section through the magnet-containing gasket detached from the refrigerator, the view being taken substantially on the line 2—2 of Fig. 1 as viewed in the direction indicated by the arrows;

Fig. 3 is a view similar to Fig. 2 but taken substantially on the line 3—3 of Fig. 1 as viewed in the direction indicated by the arrows; and

Fig. 4 is a fragmentary perspective view showing a portion of a flexible magnetic strip embodying the invention.

A refrigerator 10 of conventional construction is illustrated in Fig. 1 as comprising a cabinet body or member 11 providing a storage compartment the opening of which is closable by a door 12 that is swingably mounted on the cabinet by hinges 13 and 14. The cabinet and door contain magnetically permeable material since the shell of both of these members is formed of sheet iron or steel. The opening to the storage compartment is sealed when the door is closed by a gasket member 15 which is here shown as mounted upon the door 12 in peripherally continuous substantially rectangular configuration with reaches of the gasket extending along each side of the cabinet opening the door is closed.

The gasket 15 performs the dual function of a door seal and a latch. This is achieved by providing one or more of the reaches of the gasket with a permanent magnet 16 which extends as a single continuous length longitudinally of a reach of the gasket. The magnet 16 is provided in strip form and is flexible transversely of its length. The gasket is also formed of flexible material and has a configuration such that a portion thereof can deform when a compressive force is applied, the magnet being so located in the gasket that it is normally spaced from the attached side of the latter by flexible portions or walls of the latter. This insures complete sealing of the space between the cabinet and door when the latter is closed since the magnet holds the gasket to the cabinet and the flexible nature of the gasket and magnet permit them to accommodate to irregularities of the door and cabinet body.

The gasket 15 may take a variety of configurations. As here shown, however, this gasket comprises interconnected, longitudinally extending flexible wall portions 17, 18, 19 and 20 defining a longitudinally extending pocket or compartment 21 for the flexible magnetic strip 16 which pocket or compartment is connected at its opposite sides to a longitudinally extending flexible base portion 22 by flexible spaced longitudinally extending intermediate members or portions 23 and 24. The base portion 22 is preferably thicker than the wall members or portions 17, 18, 19, 20, 23 and 24 and is integral with a strip portion 25, the gasket being attached to the door, for example, by fitting a strip, carried by the door, between the portions 22 and 25, which thus constitute an attaching portion. Al-

ternatively, the portion 25 itself may be screwed to the door. The entire gasket, including the attaching portion, is preferably formed by extrusion from suitable elastomeric material as, for example, plasticized polyvinyl chloride.

In the illustrated embodiment, the members or portions 23 and 24 of the gasket are shown as having the edge regions thereof opposite the base member or portion 22, deflected laterally and forming with the wall portion 17 the outer wall of the gasket which contacts the cabinet body when the door is closed. There is thus provided a longitudinally extending hollow body with an interior of generally rectangular shape in cross section and with the pocket or compartment 21 contained therein behind the front or sealing wall 17 of the gasket. However, the members or portions 23 and 24 may be connected to the walls of pocket 21 at other locations if desired, for example at the respective edges of the wall 20, the function of the members 23 and 24 being that of providing a flexible and resilient support for the magnet-containing pocket or compartment upon the portions 22 and 25 so that the pocket can have limited movement relative to the portions 22 and 25 when the door is opened and closed.

The magnet member 16 comprises a finely-divided ferrite united by a binder which is a plasticized thermoplastic resin, preferably a plasticized vinyl resin. The following is a typical example of one suitable composition, the several materials being expressed in terms of parts by weight based upon 100 parts of the resin and also as a percentage of the total weight of the material:—

Material	*Parts by weight*	*Percentage of Total Weight*
Polyvinyl chloride	100	5.71
Dioctyl phthalate	82	4.69
Barium ferrite powder	1560	89.19
Barium cadmium laurate	2.34	.13
Triphenyl phosphate	1.26	.07
Low molecular weight polyethylene	3.64	.21
	1749.24	100.00

The barium ferrite powder is in finely-divided condition such that the particle sizes are in the order of a few microns, preferably in the range of 3 to 4 microns. One way in which the proper particle size may be determined readily is by providing the ferrite in sufficient fineness that it all passes through a U.S. Standard Screen of 235 mesh, that is a screen the openings of which have a transverse dimension of the order of 0.0017 inches. The dioctyl phthalate is a plasticizer for the polyvinyl chloride, the barium cadmium laurate and the triphenyl phosphate are provided as stabilizers for the poylvinyl chloride, and the polyethylene of low molecular weight serves as a lubricant during the extrusion of the material to form the elongated strip.

In preparing the magnet 16 the above-indentified ingredients are tumbled in a suitable container to mix them and thereafter the mixture is placed on a mill of the type used for milling rubber. The rolls of the mill are heated to an appropriate temperature so that the mixture reaches a temperature of approximately 280° F. and is milled for approximately 20 minutes when the size of the batch is of the order of 100 pounds. This operation produces a flexible sheet of the material which is then granulated and fed to an extruding machine having a suitable die to provide the extruded material with the desired cross-sectional dimensions. The material issues from the extruder in an elongated continuous self-supporting strip and may be coiled because of its flexible self-supporting nature. The magnetic material is magnetized by conventional equipment in such a manner and to such a degree as to constitute a permanent magnet. The magnetic operation may be performed either before the material is cut to length or just prior to incorporation of the magnet in a gasket.

An alternative mode of preparing the magnetic material 16 is to form a pre-mix of all the ingredients except the ferrite and put this pre-mix upon a mill with the barium ferrite being added upon the mill when the other ingredients have reached a plastic condition and adhere together. A still different mode of preparing the material is to make a master batch of all the ingredients except the barium ferrite in a Banbury mixer, commonly employed for rubber compounding, and then add the barium ferrite to the master batch with subsequent milling for further mixing. Other modes of handling the material will be readily apparent to those familiar with the art of preparing elastomeric or thermoplastic containing materials, the procedure being selected to produce thorough mixing of the ingredients so that, theoretically, each particle of ferrite

is covered by the thermoplastic resin.

The proportions of the ingredients may be altered and other known plasticizers and stabilizers may be employed without loss of the desired magnetic strength and flexibility in the composition. For example, another suitable composition comprises the following:—

Material	*Parts by weight*	*Percentage of Total Weight*
Polyvinyl chloride	100	6.40
Dicotyl phthalate	80.9	5.17
Lead carbonate paste	6.10	0.39
Low molecular weight polyethylene	3.64	0.23
Lead stearate paste	1.7	0.11
Barium ferrite powder	1371.4	87.70
	1563.47	100.00

A further specific example of a suitable composition is:—

Material	*Parts by weight*	*Percentage of Total Weight*
Polyvinyl chloride	100	5.76
Dioctyl phthalate	80.9	4.66
Lead carbonate paste	10.0	0.58
Lead stearate paste	1.7	0.10
Paraffin wax	5.0	0.29
Barium ferrite powder	1536.0	88.50
Butylated hydroxy toluene	2.0	.11
	1735.6	100.00

In this example, the paraffin wax is employed in place of polyethylene as a lubricant for the extrusion operation. In addition, it aids in reducing heat build-up on the mill during the mixing operation. The butylated hydroxy toluene serves as an antioxidant to prevent breakdown of the dioctyl phthalate.

The proportion of the ferrite to the thermoplastic resin may be varied by providing the ferrite within the range of 85% to 93% the total weight with corresponding alteration in the other ingredients to provide magnetic material of suitable characteristics for use in refrigerator gaskets. Within this range of variation the ingredients other than the ferrite may be provided as a master batch or mixtures based upon any of the above or equivalent formulations and a suitable amount of this master batch is used with the appropriate amount of ferrite to produce the aforementioned percentage of ferrite in the final composition. This eliminates the need for recomputing the individual amounts of each of the separate components when the amount of ferrite is altered within the range stated.

The magnetic material prepared as described above is preferably extruded as a continuous strip of rectangular cross section with the width of the strip being in the range of one-fourth to one-half inch and with the cross sectional area of the strip being .04 to .08 square inches for gaskets of the size commonly employed in domestic refrigerators. Such a strip, when magnetized, will produce sufficient magnetic attraction to hold itself against a magnetically permeable article such as the metal body of a refrigerator and thereby permits the door of the refrigerator to be held closed, but to be opened with a pull thereon which is of the order of ten pounds or less. The magnetic material in strip form may be readily inserted in the pocket or compartment of the gasket by slipping the strip therein with the strip cut or broken to a length corresponding substantially to the length of one reach of the complete gasket. Separate lengths of gasket material for the separate reaches of the cabinet may thus be prepared and united together at the corners by known sealing operations, such as dielectric heating or the like. To facilitate retaining the gasket material in proper shape during this operation, the pockets or compartments immediately adjacent the corners of the completed gasket may be filled wtih glass wool or other material, it not being necessary that the magnetic strip extend completely to the corners of the gasket.

All four sides of the completed gasket may be provided with magnetic strips in the manner just described. However, it has been found that, with certain types of hinges now employed on refrigerator cabinets, it is desirable that the reach of the

gasket adjacent the hinges not be provided with a magnetic strip. This reach of the gasket may therefore have the pocket or compartment 21 filled with glass wool or other readily deformable resilient material as is indicated at 26 in Figs. 1 and 3 of the drawing. Also, in some instances it is sufficient to have only the vertical reach of the gasket opposite the hinge side of the door provided with magnetic material in which event the upper and lower reaches of the gasket as well as the reach adjacent the hinges may be supplied with glass wool or the like.

The arrangement of the magnetic poles for the magnetic material 16 may be selected to provide the desired holding action of the magnet. One suitable arrangement is that in which continuous north and south poles are provided running respectively adjacent the longitudinal edges of the strip 16 with the magnetizing force supplied to the strip so that the maximum energy imparted in the magnetizing operation is on that surface of the magnet which will be outermost when placed in the gasket. Other arrangements of magnetic poles may be provided as for example, a plurality of poles alternating across the width of the magnet or lengthwise of the magnet. Likewise, in some instances, it may be desirable to have a plurality of magnetic poles with those of like polarity either alternating or adjacent each other. These several arrangements of magnetic poles can be readily effected because of the nature of the magnetic material which does not exhibit the properties of a steel bar when magnetized but instead permits local magnetization to be effected in accordance with any desired pattern.

A flexible magnetic material may be employed for use other than in refrigerator gaskets. In such uses it may not be necessary to provide the same magnetic strength as required for the strips employed in a refrigerator gasket and greater flexibility may be desired. Consequently, the percentage of ferrite may be reduced below the range mentioned above and suitable magnets may be prepared wherein the ferrite is present in the range of 30% to 93% of the total weight of the magnet. Thermoplastic resins other than polyvinyl chloride may be employed in forming the magnets as, for example, a copolymer of vinyl chloride with other monomers such as vinyl acetate, vinylidene chloride, methyl acrylate and similar materials. Likewise, the barium ferrite may be replaced, if desired by other ferrites or equivalent magnetic retentive properties, so that a permanent magnet can be produced by a magnetizing operation.

WHAT WE CLAIM IS:—

1. A flexible magnet comprising finely divided particles of barium ferrite or a ferrite of equivalent magnetic retentive properties, the ferrite being bonded together by a thermoplastic resin containing a plasticiser so as to make up a self-supporting body of minimum dimension greater than the thickness of a magnetic recording tape, the body being magnetised in such a manner and to such a degree as to constitute a permanent magnet able to hold itself against a magnetically permable article, the particles being present in the body in the range of 30% to 93% of the total weight of the magnet and the size of the particles being such that they all pass through a screen the openings of which have a transverse dimension of the order of 0.0017 inches.

2. A flexible magnet according to Claim 1, in which the size of the particles of ferrite is of the order of a few microns.

3. A magnet according to Claim 2 in which the particle size is of the order of 3 to 4 microns.

4. A magnet according to any of the previous claims, in which the particles of ferrite are present in the range of 85% to 93% of the total weight of the magnet.

5. A magnet according to any of the previous claims, in which the thermoplastic resin is polyvinyl chloride.

6. A magnet according to Claim 5, in which a stabilizer for the polyvinyl chloride is included.

7. A magnet according to any of the previous claims, in which the magnet is in the form of an elongated strip.

8. A magnet according to Claim 7, in which the cross-sectional area of the strip is in the range of 0.04 square inches to 0.08 square inches.

9. A gasket for the door of a refrigerator or other cabinet, comprising an elongated flexible body having a longitudinally extending portion for attaching to the door, a portion carrying a flexible magnet for attracting the cabinet body, this magnet being in accordance with any of the previous claims and extending along the body, and an intermediate portion which is integral with the other portions and which permits of a relative movement between them to allow the magnet to take up different longitudinal configurations with respect to the attaching portion.

10. A gasket according to Claim 9, in which the intermediate portion comprises two spaced, longitudinally extending walls, one being connected to the magnet-carrying portion adjacent one side of the magnet and the other being connected to this portion adjacent the other side of the magnet.

11. A gasket according to Claim 9 or Claim 10, in which the body is hollow and

the magnet is disposed in its interior.

12. A gasket according to any of Claims 9 to 11, in which the magnet is fitted in a pocket having walls integral with the body.

13. A gasket according to Claims 10 and 12, or 10 to 12, in which the pocket is disposed adjacent the sealing wall of the body and remote from the said spaced walls of the body and the attaching portion.

14. A gasket for the door of a refrigerator or other cabinet, comprising an elongated flexible body having integral front, back and side walls defining a hollow interior of generally rectangular shape in cross-section, the back wall being integral with a parallel facing extension and serving with it as a portion for attaching the gasket to the door, the front wall being integral with further walls to define an internal longitudinally extending pocket lying behind the front wall and carrying a flexible magnet for attracing the cabinet body to the front wall, the magnet being in accordance with any of Claims 1 to 8 and extending along the body, the two side walls serving to permit of relative movement between the front and back walls to allow the magnet to take up different longitudinal configurations with respect to the attaching portion.

15. A gasket according to any of Claims 9 to 14 in which the magnet extends along substantially the whole length of the body.

16. A cabinet with a door which, when closed, is held against the cabinet body by a gasket according to any of Claims 9 to 14, the gasket being an endless gasket which serves as a seal between the door and the periphery of the cabinet body around its opening.

17. A cabinet according to Claim 16, in which the gasket is secured to the door.

18. A cabinet according to Claim 16 or Claim 17, in which the magnet extends around only part of the periphery of the cabinet body around its opening, the gasket for the remainder of the periphery providing no force urging the door and cabinet body together.

19. A cabinet according to Claim 18, in which the flexible body of the gasket is uniform throughout its length, and the portion thereof not provided with a magnet contains a mass of readily deformable resilient non-magnetic material.

20. A cabinet according to Claim 19, in which the material is glass wool.

21. A cabinet according to any of Claims 18 to 20, in which the door is a rectangular hinged door, and the portion of the gasket not provided with a magnet extends at least along the edge of the periphery adjacent the hinge.

22. A cabinet according to any of Claims 16 to 21 and constructed as a refrigerator.

23. A magnet according to Claim 1, substantially as described with reference to Figure 4 of the accompanying drawings.

24. A gasket according to Claim 9, substantially as described with reference to Figure 4 of the accompanying drawings.

25. A cabinet or refrigerator substantially as described with reference to Figures 1 to 3 of the accompanying drawings.

For the Applicants:—
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903,287 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

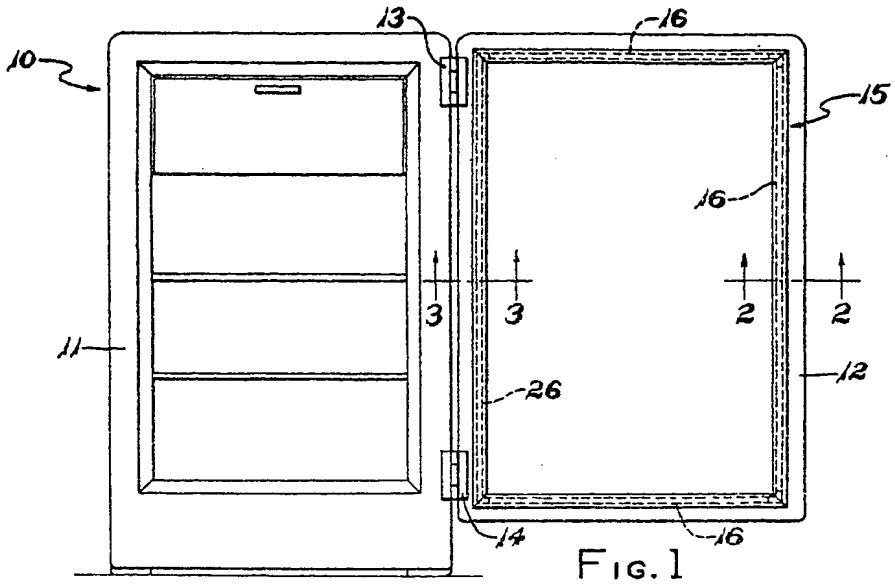

FIG. 1

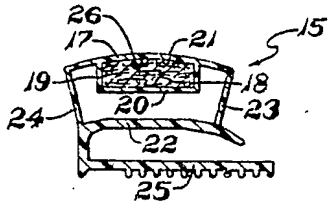

FIG. 3

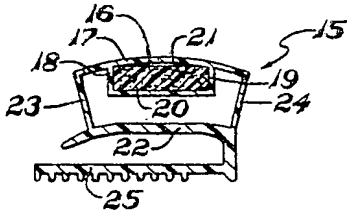

FIG. 2

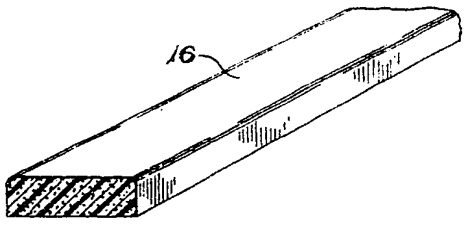

FIG. 4